

REMARKS

Claims 20-28 are now pending in the application. Claims 20-23 stand rejected. Claim 20 is amended. Support for the amendments may be found in the specification as originally filed at Figures 3A and 3B, and at paragraphs [0034]-[0038]. Claims 24-28 are added. Support for the added claims may be found in the specification as originally filed at paragraphs 34, as well as Figures 2 and 3, and paragraphs 30-31 and 47. Paragraphs 34, 30-31, and 47 respectively state in relevant part:

The operator or technician also uses the spot size of laser 205 to determine the minimum allowable tool pitch 330 of tool path 300A. For example, if the spot size is 10 microns, tool pitch 330 should be a maximum of 10 microns to prevent under-ablated ridges from forming along outer walls of the radial contours. A pitch size around two microns works well with the 10-micron laser spot.

... a constant arc speed tool path ... includes ... a plurality of exposure steps 320 having constant arc speed and spacing ... laser 205 pulses at a fixed repetition rate, the uniform ablation is translated into a constant propagation speed of PZT scan mirror 230 to direct the laser strike point onto exposure steps 320 of workpiece 255.

Another way to solve the same problem is to fire the laser at a faster rate when the hole radius is at the outer exposure steps. However, this approach requires additional process control that is difficult to synchronize and manage in the laser system.

The specification is amended to correct typographical errors at paragraph 40. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

AMENDMENT TO THE SPECIFICATION

Applicant herein amends paragraph 40 of the specification to correct typographical errors.

The amendment does not add new matter. For example, paragraph 40 states in relevant part, “Another function of $V_{\max}(i + 1) = V_{\max}(i) - (\Delta V_{\max} * i)$ makes the taper progressively steeper. On the other hand, $V_{\max}(i + 1) = V_{\max}(i) - (\Delta V_{\max} / i)$ makes the taper angle less and less steep as radius is reduced”. Accordingly, one skilled in the art can readily appreciate that the statement, “ $V_{\max}(i + 1) = V_{\max}$ results in a constant taper with fixed taper angle” is a typographical error, and infer from context the correct statement “ $V_{\max}(i + 1) = V_{\max}(i) - \Delta V_{\max}$ results in a constant taper with fixed taper angle”. Moreover, one skilled in the art would readily recognize that the statements regarding the other functions are reversed, since progressively more and less rapid decrease of V_{\max} between layers respectively results in less steep and steeper taper angles. Thus, the original statements are typographical errors that are easily corrected by switching the statements regarding their effects. Accordingly, one skilled in the art can readily infer from context that the correct statements are, “Another function of $V_{\max}(i + 1) = V_{\max}(i) - (\Delta V_{\max} * i)$ makes the taper angle less and less steep as radius is reduced ~~progressively steeper~~. On the other hand, $V_{\max}(i + 1) = V_{\max}(i) - (\Delta V_{\max} / i)$ makes the taper angle progressively steeper ~~less and less steep as radius is reduced~~.” Thus, no new matter is added.

REJECTION UNDER 35 U.S.C. § 102

Claims 20-23 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Aoki et al. (U.S. Pat. No. 5,237,148). This rejection is respectfully traversed.

The teachings of Aoki et al. are generally directed toward laser milling manufacture of a nozzle. In particular, the Examiner relies on Aoki et al. to teach a “constant arc speed” in the form of a laser that, as best understood by Applicants, is

moved along a z-axis either up (away from the workpiece) or down (toward the workpiece) at a rate controlled according to the distance along the z-axis. Accordingly, especially where Aoki teach away from moving the beam across a surface of the workpiece during ablation, Aoki et al. do not teach a tool path that describes an arc, and cannot have an arc speed at all. Moreover, Aoki et al. do not teach a tool path that describes a continuously constant arc speed achieving a continuous spiral by application of the laser beam according to a non-uniformly changing radius and angular progression during the spiral.

Applicants' claimed invention is generally directed toward a workpiece milled according to a constant tool path algorithm. In particular, Applicants' claimed invention is directed toward a workpiece milled according to a continuous spiral tool path achieved by application of a laser according to a non-uniformly changing radius and angular progression during a spiral. For example, **independent claim 20 of Applicant's claimed invention, especially as amended, recites "the tool path describes a continuously constant arc speed achieving a continuous spiral by application of the laser beam according to a non-uniformly changing radius and angular progression during the spiral."** An example of a resulting tool path is illustrated in Figures 3A and 3B of the originally filed specification. It is evident that Aoki et al. do not teach all of the elements recited in independent claim 20.

Accordingly, Applicants respectfully request that the Examiner withdraw the rejection of independent claim 20 under 35 U.S.C. §102(b), along with rejection on these grounds of all claims dependent therefrom.

REJECTION UNDER 35 U.S.C. § 103

Claims 20-23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Temple et al. (U.S. Pat. No. 6,228,311) in view of Zanomi (U.S. Pat. No. 3,961,838). This rejection is respectfully traversed.

The teachings of Temple et al. are generally directed toward forming nozzles by laser milling. In particular, the Examiner relies on Temple et al. to teach laser ablation of a workpiece according to a toolpath. However, Temple et al. do not teach, suggest, or motivate a tool path that describes a continuously constant arc speed achieving a continuous spiral by application of the laser beam according to a non-uniformly changing radius and angular progression during the spiral.

The teachings of Zanomi are generally directed toward producing a scanning laser beam of constant linear velocity. In particular, the Examiner relies on Zanomi to teach a tool path having constant or uniform angular velocity. However, Zanomi does not teach, suggest, or motivate a tool path that describes a continuously constant arc speed achieving a continuous spiral by application of the laser beam according to a non-uniformly changing radius and angular progression during the spiral.

Applicants' claimed invention is generally directed toward a workpiece milled according to a constant tool path algorithm. In particular, Applicants' claimed invention is directed toward a workpiece milled according to a continuous spiral tool path achieved by application of a laser according to a non-uniformly changing radius and angular progression during a spiral. For example, **independent claim 20 of Applicant's claimed invention, especially as amended, recites "the tool path describes a continuously constant arc speed achieving a continuous spiral by**

application of the laser beam according to a non-uniformly changing radius and angular progression during the spiral.” An example of a resulting tool path is illustrated in Figures 3A and 3B of the originally filed specification. It is evident that Temple et al. and Zanomi do not teach, suggest, or motivate all of the elements recited in independent claim 20.

Accordingly, Applicants respectfully request that the Examiner withdraw the rejection of independent claim 20 under 35 U.S.C. §103(a), along with rejection on these grounds of all claims dependent therefrom.

NEW CLAIMS

Claims 24-28 are added. Support for the added claims may be found in the specification as originally filed at paragraphs 34, as well as Figures 2 and 3, and paragraphs 30-31 and 47. Claims 24-28 each depend directly or indirectly from independent claim 20 and should be allowable for the same reasons.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

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